Central Venous Access Devices

Self-Learning Package

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Central Venous Access Devices (CVADs)

INTRODUCTION - CVAD

Traditionally, peripheral venous access has been the mainstay of intravenous therapy. However, with advanced technology, complex treatments and some critical thinking towards venous preservation, central access has become a common feature of modern health care. It is important to be cognizant that multiple peripheral venipunctures put patients at risk for:

- Infection
- Peripheral vein damage
- Extravasation
- Pain
- Nerve damage & loss of use of limb
- Induced fear of injections

Early vascular assessment is a critical intervention that identifies patients who would be a candidate for a Central Venous Access Device (CVAD). Please refer to RNAO Best Practice Guidelines Assessment and Device Selection for Vascular Access (2004) for more information on vascular assessment. Timely identification of these patients with subsequent Most Responsible Practitioner (MRP) collaboration should provide optimum infusion care.

CVADs may be inserted into a peripheral or central vein so that the tip of the catheter lies within a large central vessel, usually in the lower superior vena cava (SVC) just above the right atrium. However, when a CVAD is inserted into the femoral or saphenous vein, the catheter tip should lie in the inferior vena cava at the level of the diaphragm.

Central Venous Access Devices are inserted under sterile conditions and maintained aseptically. Most devices are inserted by physicians but peripherally inserted central catheters (PICCs) may be inserted by appropriately educated health care professionals (HCPs).

Informed patient consent must be obtained prior to insertion unless it is an emergency situation.

PURPOSE OF SELF LEARNING PACKAGE

The purpose of this package is to provide HCPs with sufficient background and theory to best enable them to care for CVADs as appropriate. HCPs who have reviewed this Self Learning Package and successfully completed the attached test may care for a CVAD. Each HCP is responsible for assessing their own knowledge skill and judgment with regards to performance of these skills and seeking assistance when needed from more experienced colleagues or the Clinical Practice Leader.

CVAD care is further supported and guided by policy C-9 “Central Venous Access Devices” in the Practice Standards Manual. Skillful and knowledgeable care of CVADs minimizes patient discomfort, enhances effectiveness of therapy and decreases the risk of complications.
LEARNING OUTCOMES

After completing this learning package the HCP should be able to:
1. Identify the basic anatomy & physiology of thoracic vascular system
2. Identify four different central devices used at RVHS and identify the indications for use of each.
3. Discuss the HCP’s role in assisting with CVAD insertion.
4. Indicate the need for X-ray/fluoroscopy as the means of verification of placement for all CVADs.
5. Discuss the role of asepsis in the care and maintenance of CVADs.
6. Describe the appearance of a typical CVAD site.
7. Describe 4 basic complications associated with CVADs.
8. Indicate 2 reasons for changing the dressing of a short term CVADs.
9. Demonstrate the steps in changing a short term, tunneled and PICC CVAD dressing.
10. Identify four reasons for flushing a CVAD.
11. Demonstrate the steps required to flush a CVAD with a positive pressure device, without a positive pressure device, and when a valve is present.
12. Identify three reasons for changing the tubing/connector on a CVAD.
13. List two complications associated with the changing of a CVAD tubing/connector.
14. Describe the steps involved in changing a CVAD tubing/connector.
15. Describe the steps involved in drawing a blood specimen from a CVAD.
16. Describe the steps involved in accessing an implanted port.
17. Identify possible reasons for a lack of blood flashback when accessing an implanted port.
18. List steps to take when no blood flashback is noted in an implanted port.
19. Describe the steps involved in de-accessing an implanted port.
20. Describe the steps involved in the removal of a Short Term (ST) CVAD and PICC line.
21. Identify steps to take if an occlusion is suspected.

Skills such as venous sampling, removal of CVAD and accessing/de-accessing of an implanted port may be identified as low frequency skills in some areas and will require yearly review of policy C-9 and the SLP to maintain competency. The HCP needs to assess his/her knowledge skill and judgment when completing this skill and seek assistance as required.

ACHIEVEMENT AND MAINTENANCE OF COMPETENCY

1. Review of the self-learning package.
2. Obtain a score of 90% or better on CVAD test.
3. Attendance at the Vascular Safety Day education session.
Central Venous Access Devices (CVADs)

WHY SUPERIOR VENA CAVA IS OPTIMAL FOR CVAD TIP PLACEMENT

The superior vena cava (SVC) is the choice for CVAD tip position as it has a large volume of rapid, turbulent blood flow, which allows for rapid administration and dilution of large volumes. This maximum dilution of infusate reduces the risk of phlebitis and vein sclerosis. This placement also allows hemodynamic monitoring.

If a multilumen device is inserted then the SVC blood flow quickly dilutes incompatible infusions from individual lumens, thus preventing any mixing.

As we move from distal smaller veins of the hands to the larger centrally located veins of the thoracic cavity we can see the increase in volume of blood flow (mL/min) that is present and permits better dilution and mixing of medications in the blood stream.

<table>
<thead>
<tr>
<th>VEIN</th>
<th>BLOOD FLOW mL/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metacarpal/Digital</td>
<td>10</td>
</tr>
<tr>
<td>Lower Arm Cephalic &amp; Basilic</td>
<td>20-40</td>
</tr>
<tr>
<td>Upper Cephalic</td>
<td>40-90</td>
</tr>
<tr>
<td>Upper Basilic</td>
<td>95-150</td>
</tr>
<tr>
<td>Axillary</td>
<td>150-350</td>
</tr>
<tr>
<td>Subclavian</td>
<td>350-800</td>
</tr>
<tr>
<td>Superior Vena Cava (SVC)</td>
<td>2000</td>
</tr>
<tr>
<td>Aorta</td>
<td>5000-6000</td>
</tr>
</tbody>
</table>
INDICATIONS for CVAD

- Long Term Therapy
  - If more than six days are anticipated for therapy, venous access should be assessed to consider the need of an intermediate or long term device (Centers for Disease Control and Prevention (CDC), 2002).

- Prescribed Therapy
  - Hypertonic Solutions, Vesicants or Irritants
    - Normal blood osmolarity is 290 mOsm/L. Normal saline has the closest osmolarity to normal blood.
    - Solutions with osmolarity > 600 mOsm/L cause phlebitis
    - Osmolarity > 500 mOsm/L should not be given through peripheral line

  - Mediations with extreme variations in pH
    - Blood pH = 7.35-7.45. A pH of 5-9 minimizes disruption of venous endothelium

  - Multiple Medications/Solutions

  - Parenteral Nutrition (TPN)

- Hemodynamic Monitoring/Diagnostics

- Poor Peripheral Access
  - May provide easier access for obtaining blood work.

- Emergency/Resuscitation

CONTRAINDICATIONS for CVAD

- Abnormal coagulopathy
- Abnormal structure/disease of upper central vasculature
- Previous radiation to upper torso
- Thrombosis of central vasculature
- Superior vena cava syndrome
- Patient condition
- Lack of expertise and resources
ADVANTAGES and DISADVANTAGES OF CVADs

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>• Can be used in the inpatient, outpatient, &amp; home/Long Term Care settings</td>
<td>• All devices require routine care</td>
</tr>
<tr>
<td>• Preserves peripheral vascular access &amp; reduces multiple sites/attempts</td>
<td>• A knowledgeable caregiver is required.</td>
</tr>
<tr>
<td>• Provides reliable venous access with immediate access to central</td>
<td>• Costly (but so are multiple peripheral sites)</td>
</tr>
<tr>
<td>circulatory system</td>
<td>• Increases potential source of infection</td>
</tr>
<tr>
<td>• Long dwell times (weeks to years)</td>
<td>• All need specialized personnel to insert and some require radiology/OR</td>
</tr>
<tr>
<td>• Improved quality of life for patients</td>
<td>for insertion</td>
</tr>
<tr>
<td></td>
<td>• Invasive Procedure for insertion</td>
</tr>
</tbody>
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IDEAL CATHETER COMPOSITION

The ideal catheter would be composed of a material that inhibits thrombus formation, inserts easily, and is biocompatible and radiopaque. Catheters must be radiopaque.

Catheters may be composed of polyurethane, silicone, or elastomeric hydrogel each with their own positive and negative characteristics.

Source: ICU Web
CATHETER DESIGNS

Catheters are available with open-ended, closed-ended, and pressure-activated safety valves (PASV). In addition, some catheters may be impregnated with antibiotic or heparin with the goal of inhibiting infections or thrombus formation.

Source: Bard Access Systems

Open-ended catheters have a blunt end. If they do not have a valve within the catheter, they require positive pressure maintenance when not in use. They can be cut at the distal open end at time of insertion to ensure the correct length for the patient.

Source: Bard Access Systems

Closed-ended catheters have a rounded closed tip. An example of a closed-ended catheter is the Groshong catheter. This specific device has a valve that opens inward for aspiration, outward for infusion, and remains closed when not in use. There are several advantages to a closed-ended, valved catheter, such as: decreased risk of bleeding or air emboli, catheter clamping is not required, heparin use can be eliminated, and the frequency of flushing is reduced.

PASV are located in the catheter hub and are similar to the positive pressure adapter valves (e.g. CLC 2000). These valves open with minimal positive pressure for infusion and require four times the negative pressure for aspiration. PASV also prevents reflux of blood into the end of the catheter and only requires weekly saline flushes.

TYPES of CENTRAL VENOUS ACCESS DEVICES

1. Short Term Central Venous Access Device (STCVAD)
2. Peripherally Inserted Central Catheter (PICC)
3. Tunneled Catheter (Hickman)
4. Implanted Port (Port-a-cath)
1. **Short Term Central Venous Access Device (STCVAD)**

- Non-tunneled, Non-cuffed Percutaneous Central Venous Catheter (CVC)
- Large bore catheter, > 8 inches long,
- Inserted directly through the skin (percutaneously) into a chosen vessel
  - jugular, subclavian or femoral.
- Subclavian is the preferred site for ease of maintenance and infection prevention.
- Single or multiple lumen options available
- Typically held in place with sutures or securement device.
- **Short term use** (days to weeks, probably less than 1 month)
  - Not suitable for long term or home therapies

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Quick bedside access and removal</td>
<td>• Highest rate of catheter related blood stream infection (CRBSI).</td>
</tr>
<tr>
<td>• Only CVAD that can be used for emergency/immediate access (other CVADs are scheduled insertions)</td>
<td>• Difficult to maintain asepsis if femoral or jugular insertion.</td>
</tr>
<tr>
<td>• Can handle multiple/high volume infusions/blood collection (multilumen)</td>
<td>• Higher risk of insertion complications</td>
</tr>
<tr>
<td>• Lowest initial cost</td>
<td>• Short term use only</td>
</tr>
<tr>
<td></td>
<td>• Require routine maintenance</td>
</tr>
</tbody>
</table>

Source: CMLsupport.com
2. **Peripherally Inserted Central Catheter (PICC)**

- Inserted through a peripheral vein (e.g. basilic *(preferred)*, median cubital, cephalic) in arm and threaded to SVC
- Inserted at bedside or in radiology with/without ultrasound or fluoroscopy
- Above antecubital fossa insertion is preferred
- Single or double lumen option
- Open or closed ended option

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Can be inserted by certified HCP</td>
<td>• May not be able to aspirate blood if catheter gauge too small</td>
</tr>
<tr>
<td>• Less traumatic insertion</td>
<td>• Blood flow may be compromised if crutches are used and if PICC in basilic</td>
</tr>
<tr>
<td>• Lower complication rates</td>
<td>• Body image (catheter outside body)</td>
</tr>
<tr>
<td>• Easily removed</td>
<td></td>
</tr>
<tr>
<td>• Less expensive than other long term CVADs.</td>
<td></td>
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At RVHS, the Navilyst Xcela and BioFlo PASV PICC are used. This PICC has the PASV technology that prevents reflux of blood into the catheter and requires weekly flushing only. Aspiration (pulling back) from these PICC lines will require additional force as the valve needs more negative pressure to open outwards. This is important when considering the possibility of blockage or difficulty aspirating blood to check for patency of the line.

The BioFlo PICC from Navilyst (purple ports as above) is a power PICC which indicates it is suitable for power injection, such as used for a CT scan when contrast is required to be injected under high pressure. It is also made from Endexo material which helps to reduce the risk of thrombus.

The Xcela PICC’s (white ports) are regular PICC lines that are NOT suitable for CT contrast injection. An additional peripheral IV line will need to be inserted for a CT scan.

Care and maintenance of the Navilyst Xcela PICC is the same as other central lines.
3. **Tunneled Catheter**

- Discovered by Dr. Hickman thus often referred to as a “Hickman”.
  - Others types of tunneled include: broviac, broviac/hickman
- Requires insertion by physician in operating room or diagnostic imaging with a local anaesthetic
- Catheter is threaded to SVC from a cutdown or percutaneous stab at venotomy (insertion) site. May require a suture to hold in place which is removed when healing occurs; about one week.
- Typical access points include: subclavian, internal or external jugular, femoral
- Catheter is tunneled through the subcutaneous tissue from an exit site on the chest to the venotomy site. Exit sites are below nipple line between nipple and sternum.
- Dacron cuff lies within the tunnel about 2 cm above exit site. Tissue heals (enmeshes cuff with fibrous tissue) around this cuff providing stability and a potential barrier to microorganisms. Does not guarantee dislodgement won’t occur.
- **Does not need dressing at exit site** once healing has taken place (time varies). Dry scar around catheter exit site, no moisture or redness indicates healing.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Long term therapy</td>
<td>• Surgical/radiological</td>
</tr>
<tr>
<td>• Repair kits available for external segment</td>
<td>• insertion/removal</td>
</tr>
<tr>
<td>• Lower infection rate than non tunneled</td>
<td>• Body image</td>
</tr>
</tbody>
</table>

Source: Christie Hospital NHS Trust  
4. **Implanted Ports**

- The parts of the port include: Portal body, septum, reservoir, and catheter
- Inserted by surgical cutdown via the subclavian, internal/external jugular, or cephalic vein. It is then threaded to SVC.
- Pocket created preferably below incision line and portal body sutured into this pocket and incision is stitched closed.
- Single or dual ports available in various sizes to accommodate patient stature
- **NB: Must be accessed aseptically with non-coring needle. The needle needs to be changed every 7 days.**
- The silicone self-sealing septum can stand up to 3600 punctures.
- Septum tightly grips needle thus decreasing the risk of dislodgement.
- Most ports are accessed from top. There are some side access styles available. The smallest needle gauge & length appropriate for therapy and patient/port is preferred.
- Reservoir inside portal body (0.2-1.5 mL). Heparin is injected after flushing to maintain patency.
- Unaccessed ports require flushing every 4 weeks.
- Catheter can be pre-attached or attached after port is implanted.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| - Long term therapy  
- Lowest risk for CRBSI  
- No site care when not in use  
- Maintenance flushing every 4 weeks if not in use  
- Body image intact when not accessed  
- No restrictions for showering/swimming when healed and not accessed | - Surgical/radiological procedure to insert/remove  
- Special needle must be used to access  
- Discomfort may be associated with accessing  
- May cause artifact on CT, MRI  
- Highest initial cost of all CVAD but maintenance cost may be less  
- Potential for needle dislodgement |

Source: www.faculty.mercer.edu

Source: Bard Access Systems
MULTILUMEN DEVICES

All devices are available in multilumen design. Multilumen devices are more than one lumen (catheter) encased inside one covering. EACH LUMEN MUST BE KEPT PATENT (flushed or infusing)

Source: faculty.mercer.edu/.../jeanchiang/Mvc-073s.jpg

DEVICE SELECTION

Optimum central device selection is guided by a collaborative approach between health care team members and the patient. However, the patient may have limited choice due to the best device for their need, the physician/HCP/radiologist preferences, availability of devices, insertion timeliness and personnel competent to care for devices.

Early vascular assessment of any patient requiring any infusion therapy is mandatory to get the most appropriate access device be it peripheral or central. Considerations include:
- Prescribed Therapy
- Duration of Therapy
- Physical Assessment
- Patient Health History
- Support System/Resources
- Device Availability
- Client Preference
The device chosen should be the least invasive, fewest lumens, and smallest gauge appropriate for the therapy and be able to last the anticipated duration of the therapy. Refer to the following algorithm from Registered Nurses' Association of Ontario (RNAO) Best Practice Guidelines Assessment and Device Selection for Vascular Access (2004).
CVAD CARE and MAINTENANCE

CARE DURING INSERTION

Institutional policies and procedures may vary in the care of central venous access devices however there are minimal standards to be adhered to.

Hand Hygiene is crucial for maintaining aseptic care for CVADs. Washing or using alcohol-based hand cleaner (if hands not soiled) is necessary for any care even if gloves are used. Remember to maintain asepsis if palpating site by washing hands and not palpating after antiseptic is used on site.

1. Maximal Barrier Precautions for Insertion for both the provider (inserter) and the patient. Provider: hand hygiene, cap with all hair under, mask covering nose & mouth tightly, sterile gown & gloves. Patient: cover head and body with large sterile drape.

2. Observe patient condition during insertion and inform physician of significant changes.

For HCP responsibilities during insertion please refer to Policy C-9.
IMMEDIATE POST INSERTION CARE

1. An x-ray/fluoroscopy must be obtained and reported post insertion before use of the CVAD. The report must be specific as to tip position i.e. at the SVC/atrial junction.
2. Secure catheter with tape and appropriate dressing. Ensure that a positive pressure device (PPD) is flushed and placed on the port of the catheter lumen.
3. Observe patient for:
   - Rapid change in breathing pattern or oxygenation which may indicate complications such as pneumothorax, air embolism, cardiac tamponade
   - Change in vital signs, e.g. irregular heart rhythm or dropped blood pressure may indicate catheter tip malposition/misplacement into the atrium
   - Excess bleeding or swelling around site may indicate trauma to artery
   - Excess oozing of fluid around site may indicate catheter damage or placement problem

Post Insertion Care for PICC Lines:

Post PICC insertion care is detailed on the PICC Insertion Order Set (Form #253). The following care must be provided for a new PICC line:

- Inspect the site Q1H and notify PICC nurse of any suspected complications.
- Apply warm compresses to PICC pathway QID x 48 hours to decrease incidence of phlebitis and to vasodilate the vein.
- Change transparent dressing after 24 hours and remove gauze at site. If oozing is still noted at exit site, reapply gauze and change dressing after 48 hours.

MAINTENANCE CARE

1. Site Care
   - **Clean, dry, occlusive dressings** on CVAD sites are very important. Purposes of the dressing include:
     - Protecting the site
     - Preventing infection
     - Stabilizing the device
   - Keep in mind that CVADs (STCVADs in particular) have a high rate of catheter related blood stream infections (CRBSIs) and many of the organisms originate from the patient’s skin. Therefore, asepsis with appropriate cleansing solution and correct technique is paramount. According to the latest research a 2% chlorhexidine with 70% isopropyl alcohol is recommended for site care. To be effective, the cleansing solution must be fully dry before applying the dressing (usually 2-3 minutes). Complete drying will also enhance the adherence of the dressing to the skin and prevent potential skin rashes and irritations caused by the cleansing agent. The entire area that is to be covered with the dressing needs to be cleansed.
   - **Do not use Adhesive remover or acetone on catheter or insertion site. This may cause permanent damage to the catheter and irritation to the skin.**
Dressings may be gauze with edges secured or 3M™ Tegaderm™ I.V. Advanced Securement Dressing. All dressings must be completely occlusive on all edges and at the catheter exit site of the dressing.

Gauze dressings should be changed every 48 hours, as the site cannot be visualized. 3M™ Tegaderm™ I.V. Advanced Securement Dressings can be changed weekly. If gauze is put under a 3M™ Tegaderm™ I.V. Advanced Securement Dressing and the site cannot be seen it is considered a gauze dressing. All dressings must be changed immediately if the integrity is compromised (wet, loose or soiled).

Gauze is often put on the site of a newly inserted device. This dressing should be changed the next day (often called initial dressing), site inspected carefully and if no oozing a 3M™ Tegaderm™ I.V. Advanced Securement Dressing may be applied and left for another 7 days.

Site Assessment for unaccessed CVADs should be done every shift. When the CVAD is accessed the site assessments should be completed Q2H and PRN as per the IV Therapy and IV Filter policy (I-I). Palpate and inspect through an intact dressing observing for pain, redness, swelling, induration, tenderness, fever of unknown origin or chills. Critical thinking skills and precise documentation are important to facilitate timely interventions.

All CVADs should have a securement device, some may also be sutured.

Maintain aseptic technique by donning mask prior to dressing change or application.

Place a temporary piece of tape on the catheter distal to the dressing site to prevent movement of the catheter, remove once securement dressing is in place.

Carefully clean one inch (1”) of the catheter from the insertion site being careful not to pull or cause the catheter to migrate.

Apply 3M™ Tegaderm™ I.V. Advanced Securement Dressing or gauze with edges secured with tape (when allergies exist to Tegaderm™ dressing).

Sterile no sting barrier film (Cavilon) can be used around edges of the dressing to promote adhesion and protect skin from irritation and breakdown. Do not wipe on catheter insertion site. Do not stretch dressing rather lay it on and mold around the catheter or non-coring needle.

Coil and tape infusion tubing as necessary.
Application Technique

1. Prepare the site according to your facility’s protocol. Allow all preps and skin protectants to dry completely. Open package and remove sterile dressing.

2. Peel liner from dressing, exposing adhesive surface. Flip dressing over so adhesive faces skin.

3. Position notched edge of dressing over catheter hub, placing stabilization border over catheter “wings”. Do not stretch dressing over skin surface. Slightly overlap the stabilization border tabs under hub of lumens.

4. Press transparent portion of dressing into place.

5. While slowly peeling off paper frame, smooth dressing edges with fingertips. Smooth dressing from centre toward edges, using firm pressure.

6. Remove sterile tape strip from paper frame. Fold edge over itself, making a small tab for easier removal. Secure strip underneath the hub, with notch facing towards the insertion site.

7. Apply documentation label over catheter hub and label according to your facility’s protocol.

8. Apply firm pressure to entire dressing to ensure optimal adhesion.

1685 Removal Technique

1. Remove tape strips applied to top of dressing.

2. Separate stabilization border tabs and gently peel the dressing back toward insertion site.

3. Slowly peel dressing back over itself while stabilizing catheter and supporting surrounding skin. A medical adhesive remover can be used if needed.
Application Technique

1 Prepare the site according to your facility’s protocol. **Allow all preps and skin protectants to dry completely.** Open package and remove sterile dressing.

2 Peel liner from dressing, exposing adhesive surface. Flip dressing over so adhesive faces skin.

3 Position notched edge of dressing over catheter hub, placing stabilization border over catheter “wings”. Do not stretch dressing over skin surface. Slightly overlap the stabilization border tabs under hub of lumen.

4 Press transparent portion of dressing into place.

5 While slowly peeling off paper frame, smooth dressing edges with fingertips. Smooth dressing from centre toward edges, using firm pressure.

6 Remove sterile tape strip from paper frame. Fold edge over itself, making a small tab for easier removal. Secure strip underneath the hub, with notch facing towards the insertion site.

7 Apply documentation label over catheter hub and label according to your facility’s protocol.

8 Apply **firm pressure to entire dressing** to ensure optimal adhesion.

PICC Removal Technique

1 Remove tape strips applied to top of dressing.

2 Separate stabilization border tabs and gently peel the dressing back toward insertion site.

3 Slowly peel dressing back over itself while stabilizing catheter and supporting surrounding skin. A medical adhesive remover can be used if needed.
2. **Maintaining Patency**

- **Infusion pumps are mandatory** for CVAD infusions to maintain flow accuracy and catheter patency. A minimum infusion rate of 15 mL/H is required for continuous infusions.

- **Each lumen** of every device must either have an infusion in progress or be “locked off.” Inadequate flushing allows residual amounts of drugs and other solutions (TPN) to remain in the catheter. Precipitates/thrombus may form and cause occlusion.

- **NOTE:** Regular turbulent saline flushes with start/stop technique help prevent precipitate/sludge formation. Flushes should be at least 10 mLs.

- All lumens must be flushed after each use including failed blood specimen attempts.

- Infusion pressures should never exceed 25-40 pounds per square inch (psi). Pressure >40 psi can cause the catheter to rupture. The psi increases with smaller syringes. Therefore a 10 mL (< 10 psi) or larger syringe should always be used for flushing/medication administration.

<table>
<thead>
<tr>
<th>Syringe Size</th>
<th>PSI when filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mL TB syringe</td>
<td>&gt;300</td>
</tr>
<tr>
<td>3 mL</td>
<td>&gt;40</td>
</tr>
<tr>
<td>5 mL</td>
<td>&gt;40</td>
</tr>
<tr>
<td>10 mL</td>
<td>&lt;40</td>
</tr>
</tbody>
</table>

- Volumes, concentrations, frequency and even solutions (saline vs. saline & heparin) for flushing vary according to device characteristics and care setting policy but the above statements are the standards for all.

- When deaccessing an implanted device at RVHS it is necessary to inject 3 mLs of heparin 100 units per mL after saline flushing to help maintain patency. Remember heparin prevents clotting, it does not dissolve thrombus.

- **POSITIVE PRESSURE when flushing has to be obtained.** Positive pressure prevents reflux of blood into the catheter and hence prevents thrombosis and occlusion. There are 3 ways to obtain positive pressure:
  1. with syringe flushing,
  2. with use of a positive pressure device,
  3. or by means of the device itself (ie: PASV in line valve).
Positive Pressure Devices (PPDs):
- PPDs are connectors placed on the lumens of CVADs. They are manufactured to prevent the reflux of blood into the catheter. Manufacturer’s directions should be followed for use.
- Used correctly, clamping is not necessary for positive pressure but most choose to clamp after flushing for safety of a possible disconnect.

Valved Devices:
Have their own means of preventing reflux. For example, Groshong catheters have a slit valve that remains neutral (closed) if there is no infusion or aspiration. These require no clamp.

Source: Bard Access Systems

3. **Administration Set and Connector Changes**

- Changing administration sets and connectors regularly is an infection control measure.
- Note that connectors may be called various names e.g. prn adaptors, intermittent injection caps, Positive Pressure Devices (PPD), reflux valves
- **Vigorous cleansing with friction of connections before disconnection is necessary as many catheter infections come from hub/connection contamination.**
- Administration set (tubing) and connector changes necessitate opening the catheter to air (negative pressure). This in turn necessitates clamping non-valved catheters and/or having the patient perform Valsalva maneuver to prevent air embolism.
- Use of manufacturer’s clamps on the catheter is preferred and convenient but if other clamps are used they must not be toothed or sharp (rupture catheter).
- Leur lock connections must be secured on all tubings/connectors to prevent accidental disconnection.
- Tubing should be looped and taped to the chest wall or shoulder to prevent stress to the connections or insertion site if pulled. It is also a cleaner environment to have them looped upwards toward the shoulder.
- Extension Sets if attached during the sterile procedure of insertion may be considered part of the device and never changed unless compromised.
- Tubings, connectors, and add-ons such as filters are changed at regular intervals as per policy and whenever integrity is compromised. This also includes removal for venous sampling, blood product infusion, or when any residual blood remains within tubing or connector.
4. **Accessing Implanted Ports**

- Non-coring safety needles are used to access implanted ports. This needle is available at a 90° angle for top access ports.
- It is possible to access an implanted port as soon as it has been placed. It may however remain tender and swollen for a few days and more difficult to palpate.
- When the implanted port is not accessed it requires minimal care. It is recommended that these ports be accessed and flushed with normal saline and heparin at regular intervals. Recommendations vary between 4 weeks and 3 or more months. RVHS policy is every 4 weeks (C-0009).
- The non-coring needle and dressing require changing every 7 days when accessed. The dressing may require more frequent changing if the integrity is compromised.

<table>
<thead>
<tr>
<th>Steps to Accessing &amp; De-accessing Implanted Port</th>
<th><img src="https://via.placeholder.com/150" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>This procedure is completed using sterile technique. Mask, sterile gloves and a sterile field is required. The skin around the port should be inspected for breakdown and infection prior to accessing. Palpate the skin to identify the location of the port. An ice pack over the area may reduce the discomfort of the needle puncture. Prime the non coring needle and extension set with PPD with a 10 mL syringe of normal saline (N/S) and place on your sterile field.</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td>Clean the area using 2% Chlorexidine with 70% alcohol sticks. Start in the center of the port using a back and forth friction motion to activate the chlorexidine. Be sure to clean all of the skin that will be covered by the dressing. Repeat this procedure 2 times using a new stick each time. Allow the skin to dry completely.</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td>Using your nondominant hand, palpate the septum of the port (making a “C” with your thumb and index finger) and anchor the port in place. Use your dominant hand to hold the the non-coring needle and aim the needle at the center of the device. Push through the skin and septum. You will feel resistance as it touches the bottom of the port.</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td>Check for placement by aspirating for blood flush back. If you are unable to obtain blood flashback refer to trouble shooting implanted ports. After blood is obtained, flush with normal saline. If swelling is observed or the patient complains of pain remove needle and notify MRP. Remove the syringe and clamp the extension set. Connect the IV tubing to the extension set. Unclamp the extension set and regulate the flow rate.</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td><em>CVAD’s should always be on an infusion pump.</em></td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td>If the non-coring needle is not flush with the skin it will be necessary to fold a piece of gauze and place it between the needle and the skin. Using sterile technique, place a 3M™ Tegaderm™ I.V. Advanced Securement Dressing over the port. Secure the extension set and tubing as required.</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
</tbody>
</table>
Removal of the non-coring needle is a sterile procedure and requires sterile glove, mask and a sterile field. An order is required as a heparin flush is needed.

1. Use a 10 mL prefilled syringe with N/S and place on the sterile field.
2. Draw up 3 mLs of Heparin 100 units/mL in a 10 mL syringe and place on the sterile field.
3. Stop the infusion and apply sterile gloves.
4. Clamp the extension set of the non-coring needle and remove the IV tubing and attach a 10 mL syringe with N/S to the PPD. Unclamp and aspirate for blood flashback.
5. If blood aspirated into tubing provide turbulent flush. Clamp tubing, apply syringe with Heparin and flush the line with 3 mL Heparin.
6. Remove the dressing. Secure the non-coring needle at the site with your non-dominant hand (two fingers on either side of port in a “V” shape) and pull straight back to remove Engage safety device on needle per manufacturer.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to flush or obtain Blood Flashback</td>
<td>Kinked tubing</td>
<td>Straighten tubing</td>
</tr>
<tr>
<td></td>
<td>Closed clamp</td>
<td>Open clamp</td>
</tr>
<tr>
<td></td>
<td>Catheter lodged against wall of vessel.</td>
<td>Reposition patient.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Raise arm on side of port.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roll patient to opposite side.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Have patient cough, sit up or take deep breath.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remove needle &amp; re-access</td>
</tr>
<tr>
<td></td>
<td>Incorrect needle placement</td>
<td>Remove needle &amp; re-access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Be sure that needle is completely inserted through septum and into reservoir.</td>
</tr>
<tr>
<td>Clot Formation</td>
<td>Notify MRP. May require instillation of fibrinolytic agent. <strong>Do provide excessive force when attempting to flush.</strong></td>
<td></td>
</tr>
<tr>
<td>Kinked Catheter, catheter migration, port rotation</td>
<td>Notify MRP immediately. <strong>Do not attempt to start infusion.</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Inability to Palpate Device | Deeply implanted port/obesity | Observe for port insertion scar. Seek assistance from another nurse. Use a longer non-coring needle to access port. |

5. **Blood Withdrawal/Venous Sampling**

- Blood sampling from CVADs is another use of the devices. However, this is not a practice for every time and every patient as there are risks and benefits.

- **Benefits**
  - minimizes peripheral punctures
  - gives easy access if peripheral veins are not suitable
  - lessens patient anxiety

- **Risks**
  - handling, mishandling and repeated opening of the catheter increases the risk of infection/air embolus
  - a discard specimen is taken with most methods and this may be an issue if done many times daily for patient condition or for infants
• HCPs with demonstrated competence are required to access the CVAD and it may be more convenient, quicker, and more cost effective to do peripheral specimens if possible (phlebotomy/lab)
• increases thrombus/occlusion risk especially if not flushed adequately
• inaccurate results may occur if doing coagulation, drug levels due to inadequate flush, inadequate waste or drugs adhering to catheter wall

❖ The actual procedure is in policy C-9 but here are a few tips and reminders:
  • Stop all infusions for one minute prior to taking samples, clamp all lumens except the one the sample will be taken from
  • Discard pre-determined specimen (at least 5 mL)
  • Have a dedicated lumen for specimens if possible
  • Flush vigorously with minimum of 20 mL NS post specimen (even if resuming an infusion a flush is mandatory) Flush even if unsuccessful obtaining specimen
  • Change the PPD following the blood sampling
  • Resume all infusions
  • Blood may hemolyze if slow return
  • If results are significantly different from previous or unusually abnormal without cause, a peripheral specimen should be taken to compare or if not possible repeat with a bigger discard.
  • Syringe or vacutainer method can be used with most devices. Use appropriate transfer device to ensure integrity of the specimen and personal safety (see below).
  • Follow device manufacturer’s instructions for use and RVHS policy (C-009)
  • Correctly identify patient and label specimen tube carefully and completely at the bedside

5. Removal of Device

❖ A device can remain in place as long as the device is needed, is not a source of sepsis and/or complications as per Health Canada and Centers for Disease Control (CDC).
❖ Tunneled and implanted devices are removed by physician.
❖ HCP competent in this skill can remove short-term STCVADs and PICCs.
- Instruct patient to hold their breath when removing STCVAD from the jugular or subclavian sites to prevent an air embolism.

- Integrity of the device is determined upon removal and documented. If any resistance is encountered while attempting to remove, stop, try again and notify physician if still unable to remove.

The following chart summarizes the C-9 Policy guidelines for various care activities of the CVAD.

<table>
<thead>
<tr>
<th>Nursing Activity</th>
<th>Accessed line</th>
<th>Non-accessed line</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flushing line</strong></td>
<td>With dressing change, tubing changes &amp; PRN</td>
<td>Q7days</td>
</tr>
<tr>
<td></td>
<td>After blood products or sampling</td>
<td></td>
</tr>
<tr>
<td><strong>Change PPD</strong></td>
<td>Q7days with dressing change</td>
<td>Q7days</td>
</tr>
<tr>
<td></td>
<td>After blood products or sampling</td>
<td></td>
</tr>
<tr>
<td><strong>Change dressing &amp; Stat lock</strong></td>
<td>When compromised and Q7days</td>
<td>When compromised &amp; Q7days</td>
</tr>
<tr>
<td><strong>Tubings</strong></td>
<td>Q4days (unless lipids Q24h)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Implanted Port</strong></td>
<td>As above</td>
<td>Flush with normal saline 10mL followed by 3mL heparin (1:100 units/mL) every 4 weeks</td>
</tr>
<tr>
<td></td>
<td>Change non-corning needle with dressing change every 7 days</td>
<td></td>
</tr>
</tbody>
</table>
COMPLICATIONS

While the advantages of CVAD use far outweigh the disadvantages, HCPs need to be vigilant for the potential complications and adverse reactions associated with central venous therapy. It is estimated that approximately 10% of all patients who have a central line will experience a complication secondary to the catheter insertion or its use.

**Infection/Sepsis (local/systemic)**

*pathogenic microorganisms at insertion site or in blood*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increased WBC</td>
<td>• Handling/mishandling</td>
<td>• Maximum sterile precautions on insertion</td>
</tr>
<tr>
<td>• Febrile</td>
<td>• Break in asepsis/sterility</td>
<td>• Aseptic care</td>
</tr>
<tr>
<td>• Tachycardia</td>
<td>• Hematogenous seeding</td>
<td>• Daily assessment of site</td>
</tr>
<tr>
<td>• Hypotension</td>
<td>• Adherence of bacteria to fibrin (sheath or thrombus)</td>
<td>• Antibiotics</td>
</tr>
<tr>
<td>• +ve site/blood cultures</td>
<td>• Patient condition especially those with compromised immune system</td>
<td>• Dressing protocol for site sepsis</td>
</tr>
<tr>
<td>• Pain, erythema, discharge (site)</td>
<td></td>
<td>• Removal if catheter proven cause</td>
</tr>
<tr>
<td>• Altered mental status</td>
<td></td>
<td>• Regular assessment of need for device especially CVC and prompt removal if not needed</td>
</tr>
<tr>
<td>• <strong>May progress to septic shock and even death</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Occlusion (partial/complete)**

*inability to infuse and/or aspirate blood*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inability to infuse/flush or aspirate blood</td>
<td>• Thrombus formation intraluminal or extraluminal</td>
<td>• <strong>Regular flushing and proper stop-start flushing techniques can prevent this problem</strong></td>
</tr>
<tr>
<td>• Sluggish infusion/flush or aspiration</td>
<td>• Medication precipitate</td>
<td>• Flush routinely, post meds, and with venous sampling.</td>
</tr>
<tr>
<td>• Inability to aspirate blood but can flush easily</td>
<td>• Non-coring needle not in reservoir</td>
<td>• Monitor function</td>
</tr>
<tr>
<td></td>
<td>• Pinch-off syndrome (catheter is positioned between clavical and 1&lt;sup&gt;st&lt;/sup&gt; rib causing a positional occlusion)</td>
<td>• Awareness of drug incompatibilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lysing agents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Expert insertion</td>
</tr>
</tbody>
</table>
**Thrombosis**

formation/presence of blood clot that impedes circulation

Fibrin begins to form in response to the trauma of insertion and a foreign body in the vein. Thrombus occurs in 60% of all devices inserted, many of them exhibiting no symptoms. Thus one can see that vigilant care and maintenance (flushing) are very important.

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Edema of face, neck, arm on cannulated side</td>
<td>• Venous stasis</td>
<td>• Monitor function &amp; report changes</td>
</tr>
<tr>
<td>• Collateral circulation on chest wall</td>
<td>• Large, stiff catheter</td>
<td>• Adequate flushing</td>
</tr>
<tr>
<td>• Change in functional ability of device (sluggish flow)</td>
<td>• Pt. Disposition</td>
<td>• Lysis therapy</td>
</tr>
<tr>
<td>• Superior vena cava syndrome (blockage in the flow of blood through the SVC causing venous distension in the upper body)</td>
<td>• Dehydration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Trauma to vessel wall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Disease status</td>
<td></td>
</tr>
</tbody>
</table>

**Extravasation/Infiltration**

fluid infusing into tissue

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Patient reports</td>
<td>• Damaged/severed catheter</td>
<td>• Stabilization</td>
</tr>
<tr>
<td>• Swelling</td>
<td>• Dislodgement of port needle</td>
<td>• No vesicants without blood return</td>
</tr>
<tr>
<td>• Burns/Stings with infusion/flush including NS</td>
<td>• Misplaced catheter</td>
<td>• Lyse sluggish line</td>
</tr>
<tr>
<td>• Pain</td>
<td>• Backflow from fibrin sheath</td>
<td>• Radiologic investigation</td>
</tr>
<tr>
<td>• Redness Leaking</td>
<td></td>
<td>• Leave non-coring needle in situ if extravasation</td>
</tr>
<tr>
<td>• Warmth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No blood return</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: www.faculty.mercer.edu
**Air Embolism**
*air in vascular system potential to obstruct circulation*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chest pain</td>
<td>• Can happen at insertion or later</td>
<td></td>
</tr>
<tr>
<td>• Dyspnea</td>
<td>• Device not clamped</td>
<td></td>
</tr>
<tr>
<td>• Hypoxia</td>
<td>• Connections not tight or come apart</td>
<td></td>
</tr>
<tr>
<td>• Apnea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tachycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hypotension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Precordial murmur</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clamp catheter</td>
<td></td>
</tr>
<tr>
<td>• Place patient on left side, trendelenberg</td>
<td></td>
</tr>
<tr>
<td>• Oxygen</td>
<td></td>
</tr>
<tr>
<td>• Get help</td>
<td></td>
</tr>
</tbody>
</table>

**Catheter Tip Malposition/Misplacement**
*catheter tip not in optimal position (lower 1/3 SVC)*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Radiological</td>
<td>• Insertion</td>
<td></td>
</tr>
<tr>
<td>• Functional</td>
<td>• Increased intrathoracic pressure (sneezing, vomiting, coughing)</td>
<td></td>
</tr>
<tr>
<td>• Increased external length</td>
<td>• Jet effect from flushing</td>
<td></td>
</tr>
<tr>
<td>• Sensation of gurgling in ear</td>
<td>• Pull on outside</td>
<td></td>
</tr>
<tr>
<td>• Arm, shoulder, back discomfort</td>
<td>• Poor securement</td>
<td></td>
</tr>
<tr>
<td>• Edema</td>
<td>• Body movement</td>
<td></td>
</tr>
<tr>
<td>• Chest pain</td>
<td>• Twiddler’s syndrome (caused by patient “twiddling” with the catheter)</td>
<td></td>
</tr>
<tr>
<td>• Arrhythmia</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Monitor functional ability of device</td>
<td></td>
</tr>
<tr>
<td>• <strong>Initial X-ray confirmation is a must</strong> and at any time reposition, transfer from outside is suspected</td>
<td></td>
</tr>
<tr>
<td>• Securement device, sutures intact</td>
<td></td>
</tr>
<tr>
<td>• Monitor S&amp;S</td>
<td></td>
</tr>
<tr>
<td>• Flush with “jet” injection may resolve as well as cause</td>
<td></td>
</tr>
<tr>
<td>• May resolve on own</td>
<td></td>
</tr>
</tbody>
</table>

**Catheter Tip Malposition/Misplacement**
*Pneumothorax (air or gas in pleural cavity)*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chest pain</td>
<td>• Pleural puncture (usually at insertion)</td>
<td></td>
</tr>
<tr>
<td>• Decreased breath sounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Drop in B/P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weak rapid pulse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unilateral chest expansion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Can be asymptomatic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Treat symptoms</td>
<td></td>
</tr>
<tr>
<td>• Oxygen</td>
<td></td>
</tr>
<tr>
<td>• May require chest tube</td>
<td></td>
</tr>
<tr>
<td>• X-ray to confirm diagnosis</td>
<td></td>
</tr>
</tbody>
</table>

29
### Catheter Tip Malposition/Misplacement

#### Hemothorax *(blood in pleural cavity)*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Same as pneumothorax</td>
<td>• Trauma to vessel or adjacent ones</td>
<td>• Same as pneumothorax</td>
</tr>
</tbody>
</table>

#### Hydrothorax *(fluid in pleural cavity)*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
</table>
| • Same as pneumothorax | • Catheter transects vein into thorax and IV fluids infused into chest | • Same as pneumothorax  
  • Discontinue infusion & device |

#### Cardiac Tamponade *(heart compressed– blood/ fluid in pericardium)*

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
</table>
| • Decreased tissue perfusion  
• Hypotension  
• Tachycardia  
• Confusion/  
• agitation/panic  
• Change in colour  
• Muffled heart sounds | • Pericarditis  
• Surgical or acute trauma | • Monitor cardiac status, fluid, electrolytes, renal function, respiratory, tissue perfusion  
• O2 therapy  
• Prepare for pericardial tap |

#### Arterial Puncture

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
</table>
| • Rapid site hematoma  
• Pallor  
• Tachycardia  
• Hypotension  
• Respiratory distress (tracheal compression) | • Artery puncture during insertion | • Remove  
• Apply pressure |
Catheter Tip Malposition/Misplacement
Arrhythmias

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Irregular cardiac rhythm</td>
<td>● Tip in atrium/ventricle</td>
<td>● Reposition</td>
</tr>
</tbody>
</table>

Catheter Embolism (Separation)
portion of catheter in bloodstream (potential to obstruct)

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
</table>
| ● Chest pain
● Arrhythmias
● Infiltration | ● Shearing of catheter by insertion needle
● Catheter rupture or disconnect from portal | ● Apply tourniquet if peripheral insertion (PICC or pas port)
● Radiology consult (for snaring) |

Catheter Damage
damage to external portion

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>Causes</th>
<th>Prevention/Interventions</th>
</tr>
</thead>
</table>
| ● Leaking from device | ● Shearing of catheter
● Rupture of catheter
● Traumatic removal of guidewire | ● Repair or remove |

BLOCKED CATHETERS

CVAD catheters may become blocked. A blocked, or occluded, catheter may exhibit the following:

- Inability to flush or aspirate (complete occlusions)
- Increased resistance while flushing, and/or a catheter that fails to provide blood return (partial occlusion)
- Presence of fibrin sheath at distal end of the catheter (withdrawal/partial occlusion).

If any of the above are encountered, assess the catheter for any manual problems such as kinks in the line, clamps or changing the PPD. If the above problems continue, notify MRP and document interventions. Refer to Policy U-2 “Unblocking a Central Venous Access Device due to Thrombotic Occlusion” and consider the use of Alteplase (Cathflo). Alteplase administration is an added nursing skill that only certified HCPs are able to perform.
**DOCUMENTATION**

Documentation is a tool of communication to our co-workers, promotes continuity of care within institutions, upon discharge to continuing care or home care and serves as a reference for future need. Good documentation provides information that can lead to quick resolution of problems and preserve the device.

What **NEEDS** to be documented?

- Patient’s informed consent prior to insertion (unless an emergency situation)
- Date and time of device insertion, vein used and any failed attempts, insertion technique, use of ultrasound, fluoroscopy, sedation.
- Type of device, size, number of lumens, manufacturer, lot number, length and external length
- Tip position verified
- Flush solution used and ease of blood return and flushing
- Appearance of site, site care
- Dressing type and if occlusive, why changed (routine, problem), describe drainage if any and if swabbed
- Capped or infusion in progress with pump
- If accessing implanted device state gauge and length of needle inserted, condition of skin over portal if reaccesssing
- Removal documentation to include integrity of device
- Patient response to procedure/care
- Any patient/family teaching, materials given and perceived comprehension
- Give manufacturer’s card to patients and advise them to carry it all the time. Information should include type of device, frequency of care etc.
- Anything unusual and action taken, any remarkable deviations from policy and procedure.
- MRP or ordering practitioner notified and what was the response.
PATIENT/FAMILY TEACHING

- Education to patients/families is important even if they are not going to be managing their own care. Minimal education consists of what the device is, how important it is to them, and signs and symptoms of complications that need to be reported.

- Refer to RNAO BPG Care and Maintenance to reduce Vascular Access Complications, 2008 for detailed information

- Assess what the patient knows and proceed from the known to the unknown with most important information given first (the need to know first)

- Show the patient/family a sample of the CVAD if possible and show how it will be inserted. Inform them how the device will look and feel immediately post insertion.

- Discuss home care of the device and if the patient/family are comfortable to learn care. If not who will be responsible and have that alternative in place.

- Include family/caregiver

- Assess client’s recall/comprehension at end

- Provide contact number for further needs/questions
CARE OF CVAD
The following checklists can help guide you in the care of CVADs.

### PREPARATION FOR INSERTION

<table>
<thead>
<tr>
<th>Step</th>
<th>Task Description</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Review of policy C-9; Explain procedure to patient; wash hands.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Collect all necessary equipment</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Position patient as required</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Assist physician to set up the tray.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Under sterile conditions, flush lumens and PPDs as requested by physician/NP.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Ensure X-ray is performed immediately to determine position of catheter.</td>
<td></td>
</tr>
</tbody>
</table>

### DRESSING CHANGE

<table>
<thead>
<tr>
<th>Step</th>
<th>Task Description</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Review of policy C-9; Explain procedure to patient; wash hands.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Don mask to maintain aseptic technique. Set up sterile field using a dressing tray and place</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Apply clean gloves and remove old dressing from distal end of catheter towards insertion</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Assess catheter site for pain, redness, swelling, induration, tenderness. If signs of infection</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Using sterile gloves cleanse site with chlorhexidine, starting at insertion site and working in</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Apply 3M™-Tegaderm™ I.V. Advanced Securement dressing over catheter insertion site.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Coil and tape I.V. tubing’s as necessary.</td>
<td></td>
</tr>
</tbody>
</table>

### TUBING/CONNECTOR CHANGE

<table>
<thead>
<tr>
<th>Step</th>
<th>Task Description</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Review of policy C-9; Explain procedure to patient; wash hands. Collect all necessary equipment</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Prime new tubing/connector while maintaining asepsis.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Wash hands and apply gloves and mask.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Stop infusion of desired lumen. Clamp catheter except for valved catheters.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Using aseptic technique, cleanse connection sites well with chlorhexidine swabs using friction.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Disconnect the old tubing/connector.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Immediately connect the new tubing/connector.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Unclamp catheter and resume infusion or flush according to policy.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Complete same procedure for all other lumens or ports.</td>
<td></td>
</tr>
<tr>
<td>FLUSHING</td>
<td>Done</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>1. Ensure order is on chart when heparin is required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Collect all necessary equipment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cleanse end of PPD using friction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Connect a 10 mL NS syringe and aspirate just until blood observed in line then flush using turbulent method.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Turbulent flush with 10 mL N/S. Repeat procedure for each unaccessed lumen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. For implanted devices follow with 3mL of 100 units/mL (300 units) heparin.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISCONTINUING INFUSION</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>To disconnect from CVAD follow procedure for the changing connections (except for implanted devices).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSING AN IMPLANTABLE PORT</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review of policy C-9; Explain procedure to patient; wash hands. Collect all necessary equipment and set up a sterile field.</td>
<td></td>
</tr>
<tr>
<td>2. Don sterile gloves and mask.</td>
<td></td>
</tr>
<tr>
<td>3. Flush Non-coring needle tubing with Normal Saline.</td>
<td></td>
</tr>
<tr>
<td>4. Cleanse skin over port using a back and forth motion, using two chlorhexidine swabs. Cover the entire area of skin that the dressing will cover.</td>
<td></td>
</tr>
<tr>
<td>5. Palpate for port septum.</td>
<td></td>
</tr>
<tr>
<td>6. Anchor port with non-dominant hand, aim non-coring needle into the center of the device pushing the needle through the skin until you reach the back of the port.</td>
<td></td>
</tr>
<tr>
<td>7. Aspirate for blood return, if no blood return follow these steps:</td>
<td></td>
</tr>
<tr>
<td>1. Ask the patient to raise arms over head.</td>
<td></td>
</tr>
<tr>
<td>2. If still unsuccessful, repeat step 1.</td>
<td></td>
</tr>
<tr>
<td>3. If still unsuccessful, notify MRP or ordering practitioner.</td>
<td></td>
</tr>
<tr>
<td>8. If blood returns flush with 10 cc Normal Saline</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DE-ACCESSING AN IMPLANTABLE PORT</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review of policy C-9; Explain procedure to patient; wash hands. Collect all necessary equipment.</td>
<td></td>
</tr>
<tr>
<td>2. Ensure order is on chart.</td>
<td></td>
</tr>
<tr>
<td>3. Collect all necessary equipment</td>
<td></td>
</tr>
<tr>
<td>4. Apply clean gloves</td>
<td></td>
</tr>
<tr>
<td>5. Remove old dressing pulling the transparent dressing towards non-coring Needle.</td>
<td></td>
</tr>
<tr>
<td>6. Stop all infusions</td>
<td></td>
</tr>
<tr>
<td>7. Don sterile gloves</td>
<td></td>
</tr>
<tr>
<td>8. Connect a 10 mL syringe to the connector. Draw back on catheter until blood is observed, clamp and discard this syringe if blood enters the syringe.</td>
<td></td>
</tr>
</tbody>
</table>
9. Flush with 10 mL N/S using turbulent flush method
10. Immediately follow flush with 3 mLs Heparin 1:100 solution.
12. Pull non-coring needle out of septum according to manufacturer’s instructions.
13. Document de-accessing in patient’s chart and administration of Heparin in MAR.

<table>
<thead>
<tr>
<th>REMOVAL OF SHORT TERM CVADs OR PICC CATHETERS</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review of policy C-9; Explain procedure to patient; wash hands.</td>
<td></td>
</tr>
<tr>
<td>2. Ensure order is on chart.</td>
<td></td>
</tr>
<tr>
<td>3. Instruct and practice Valsalva maneuver with patient if jugular or subclavian STCVAD inserted.</td>
<td></td>
</tr>
<tr>
<td>4. Collect all necessary equipment</td>
<td></td>
</tr>
<tr>
<td>5. Put on clean gloves</td>
<td></td>
</tr>
<tr>
<td>6. Position patient supine; for PICC catheters adduct arm to 90° angle</td>
<td></td>
</tr>
<tr>
<td>7. Remove old dressing including securement device or sutures. Inspect insertion site. (If catheter tip is to be sent for C&amp;S change to sterile gloves and place sterile drape).</td>
<td></td>
</tr>
<tr>
<td>8. Have patient perform valsalva maneuver or hold breath during withdrawal of line (if jugular or subclavian line). With your non-dominant hand place sterile gauze over site and then withdraw catheter with smooth, gentle motion.</td>
<td></td>
</tr>
<tr>
<td>9. Apply manual pressure over the site for 1-5 minutes or longer if patient is on anticoagulant using sterile gauze. Apply dry gauze pressure dressing for 24 hours.</td>
<td></td>
</tr>
<tr>
<td>10. Inspect the catheter carefully for integrity.</td>
<td></td>
</tr>
<tr>
<td>11. Document the procedure in the integrated record and on the nursing kardex/care plan.</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


Central Venous Access Device Test

All HCPs providing care for patients with a CVAD are required to complete this test. Return your completed test to the Clinical Practice Leader for your unit.

1. Which of the following would be appropriate reasons for a central line to be inserted into a patient on your unit?
   a. The patient was admitted to your unit the previous year and it was known that it was difficult to obtain intravenous access.
   b. The patient has pneumonia and will probably require IV antibiotics for a 5 day period.
   c. The patient has been ordered Total Parenteral Nutrition (TPN) and will likely require treatment for a prolonged period of time.
   d. All of these answers are correct

2. The tip of the CVAD device inserted via the chest wall or upper limb should ideally be placed:
   a. In a large central vein with the tip of the catheter just inside the atrium.
   b. In the distal portion of the superior vena cava just above the right atrium.
   c. Inserted into a peripheral vein with the tip inside the superior vena cava.
   d. Approximately 10 cm from the insertion site of the catheter.

3. The reasons for selecting the superior vena cava for placement of a CVAD include:
   a. turbulent blood flow for optimal mixing of infusants.
   b. easy accessibility.
   c. an average blood flow of 500 mL/min.
   d. None of these answers are correct

4. Which of the following would be considered a contraindication for the insertion of a CVAD?
   a. Elevated leukocyte count
   b. Myocardial Infarction
   c. Pneumonia
   d. Increased INR

5. When changing the dressing over a STCVAD it is important to:
   a. Use aseptic technique, clean the wound with chlorhexidine and apply an occlusive sterile transparent semi-permeable membrane dressing.
   b. Use aseptic technique, clean the wound with normal saline and apply clean gauze and secure firmly with tape.
   c. Use aseptic technique to clean the wound and leave open to the air to allow healing.
   d. Use standard precautions, clean the wound with chlorhexidine and apply a dry dressing.
6. This CVAD is usually inserted just above the antecubital fossa and is threaded to the Superior Vena Cava.
   a. Non-tunneled, non–cuffed Short term Central Venous Access Device (STCVAD)
   b. Peripherally Inserted Central Catheter (PICC)
   c. Tunneled Catheter (Hickman)
   d. Implanted Port (Port-a- cath)

7. This CVAD may be inserted into the jugular, subclavian or femoral vein and is often inserted in emergency situations when immediate access is required.
   a. Non-tunneled, non–cuffed Short term Central Venous Access Device (STCVAD)
   b. Peripherally Inserted Central Catheter (PICC)
   c. Tunneled Catheter (Hickman)
   d. Implanted Port (Port-a- cath)

8. This CVAD is surgically inserted into the subclavian, internal/external jugular or cephalic vein and is accessed using a non-coring needle.
   a. Non-tunneled, non–cuffed Short term Central Venous Access Device (STCVAD)
   b. Peripherally Inserted Central Catheter (PICC)
   c. Tunneled Catheter (Hickman)
   d. Implanted Port (Port-a- cath)

9. This CVAD is threaded through a cut down site with a portion of the catheter under the skin and the lumens of the catheter outside the chest wall.
   a. Non-tunneled, non–cuffed Short term Central Venous Access Device (STCVAD)
   b. Peripherally Inserted Central Catheter (PICC)
   c. Tunneled Catheter (Hickman)
   d. Implanted Port (Port-a- cath)

10. When a gauze dressing is used for the initial insertion of a CVAD it should be kept in place for 7 days to reduce the risk of exposure to microorganisms.
    a. True
    b. False

11. When a transparent semi-permeable membrane dressing is used it should be changed every 7 days provided the integrity of the dressing is not compromised.
    a. True
    b. False

12. Site redness, tenderness, fever and swelling may be signs of infection.
    a. True
    b. False

13. Routine flushing of a CVAD can help to decrease the possibility of thrombus formation and drug precipitates in the catheter lumen.
    a. True
    b. False
14. To prevent the possibility of extravasation, always assess blood return from the line before starting the infusion.
   a. True
   b. False

15. If you suspect the CVAD catheter is blocked, immediately notify the physician/NP and prepare to administer a lysing agent.
   a. True
   b. False

16. A patient is assessed and it is determined there is a need for continued therapy at home. It is also expected that the need will be for less than 3 months. Ideally, consideration should be given to:
   a. An implanted port
   b. A PICC
   c. A tunneled catheter
   d. A non-tunneled catheter

17. Which nursing intervention is most appropriate if the patient has accidentally pulled out their PICC?
   a. Administer CPR
   b. Apply a pressure dressing to the insertion site
   c. Ask the patient to do the Valsalva maneuver
   d. All of these answers are correct

18. When accessing a CVAD for flushing, always use at least a _______-sized syringe.
   a. 5 mL
   b. 3 mL
   c. 10 mL
   d. 20 mL
19. When **deaccessing** a CVAD, what is the minimal amount of Normal Saline required to flush?
   a. 5 mL
   b. 10 mL
   c. 25 mL
   d. 60 mL

20. A dressing is required for a Tunneled CVAD at all times to prevent infection at the exit site.
   a. True
   b. False

21. Advantages of a valved catheter include:
   a. less frequent flushing of the line is needed.
   b. clamping of the line is not required.
   c. heparin use can be eliminated.
   d. All of these answers are correct.

22. The **initial** dressing on a PICC insertion site is changed after:
   a. 24 hours
   b. 48 hours
   c. 7 days
   d. 10 days

23. A patient with a PICC line complains of a swishing noise in his ear when the line is flushed. This could be an indication:
   a. That the tip of the catheter has migrated into the jugular vein.
   b. That the CVAD is patent and is being thoroughly flushed.
   c. Of a CVAD associated infection.
   d. Of a pulmonary embolus.

24. Chest pain, shortness of breath and cyanosis are signs of:
   a. A localized CVAD related infection
   b. Pinch – off syndrome
   c. A venous thrombosis
   d. A pulmonary embolism

25. A turbulent, pulsating flush method is used when flushing a CVAD because it:
   a. Reduces the PSI pressure of the catheter
   b. Reduces the risk of pneumothorax
   c. Eliminates the need for a heparin flush
   d. Helps to dislodge fibrin and medication residue from the internal lumen

26. An implanted port, when not in use, should be flushed:
   a. Daily with normal saline
   b. Once a week with heparin and normal saline
   c. Every 4 weeks with heparin and normal saline
   d. Every three days with heparin
27. Implanted ports have a number of advantages which include all of the following except:
   a. Lower risk of CVAD related infection
   b. Ability to withstand repeated access
   c. Enhanced body image
   d. Easily removed by a trained nurse upon when therapy completed.

28. The newly inserted PICC catheter requires warm compresses over the site to prevent phlebitis of the vein.
   a. True
   b. False

29. Specially trained nurses may remove tunneled and implanted CVADs.
   a. True
   b. False

30. If the catheter is occluded or there is resistance upon flushing or infusion the HCP will:
   a. Check the tubing and under the dressing for clamps or kinks
   b. Attempt to gently irrigate with 10 mLs syringe of N/S
   c. Contact the MRP for a possible order for a lysing agent.
   d. All of these answers are correct

31. The volume and concentration of heparin used to flush an implanted port for an adult patient is:
   a. 3 mL of 10 units/mL
   b. 3 mL of 100 units/mL
   c. 3 mL of 1000 units/mL
   d. 3 mL of 10,000 units/mL

32. The type of needle required to access an implanted Port is a:
   a. 20 gauge IV needle
   b. Non-coring needle
   c. Groshong needle
   d. 25 gauge butterfly needle

33. When not in use, an implanted Port must be flushed every:
   a. 4 weeks
   b. 8 weeks
   c. 7 days
   d. 2 weeks

34. Swelling and burning are evident around an implanted port during infusion or flushing. This is an indication of:
   a. Infiltration
   b. Cardiac tamponade
   c. Pulmonary embolus
   d. None of these answers are correct
35. It is not always necessary to obtain blood flashback when accessing an implanted port as long as you are able to flush the port easily with normal saline.
   a. True
   b. False

36. How long should you wait after stopping a continuous infusion, before drawing a blood sample?
   a. 2 minutes
   b. 5 minutes
   c. 15 seconds
   d. 1 minute

37. After blood sampling from a CVAD you should always:
   a. Flush the line with 5 mL of Normal Saline
   b. Flush with a minimum of 20 mls Normal Saline and change the PPD
   c. Change the IV tubing and flush with Normal Saline
   d. None of these answers are correct

38. It is necessary to change the PPD on the CVAD every 7 days with the dressing change.
   a. True
   b. False

39. What essential elements are required prior to a nurse removing a CVAD?
   a. Practitioner order and assess the coagulation bloodwork for risk of bleeding.
   b. Practitioner order and CXR
   c. Hold all anti-coagulation for 24 hrs.
   d. All of these answers are correct

40. When you are removing your patients STCVAD from the jugular or subclavian site it is important to ask them to hold their breath because:
   a. It helps to prevent an air embolism.
   b. It provides a distraction for the patient to reduce the pain and discomfort of this procedure.
   c. It helps to prevent a pulmonary embolism.
   d. It pushes a small amount of blood to the exit point of the catheter and promotes clot formation at the exit site.